Heavy Frame.

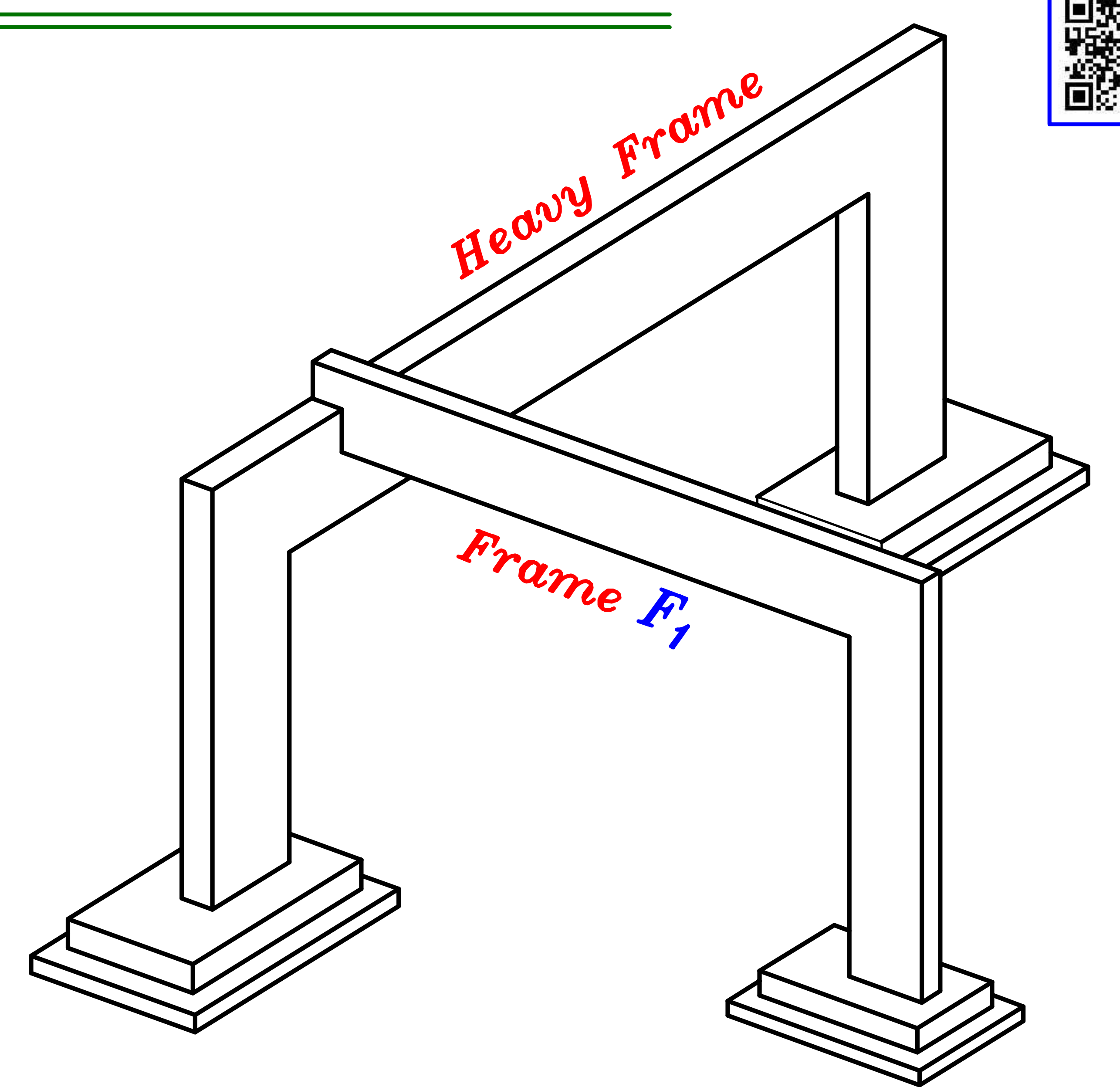
نسألكم الدعاء

IF you download the Free ***APP.*** RC Structures  *on your smart phone or tablet, you will be able to play illustrative movies For any paragraph that has a QR code icon* 

اذا حملت تطبيق RC Structures  على تليفونك المحمول او اللوح السطحى ستستطيع أن تشغل أفلام شرح للمقاطع التى تحتوى على رمز 

Heavy Frame. Table of Contents.

Concrete Dimensions.



هو عباره عن **Frame** يحمل **Frames** أخرى

و ممكن أن يكون **2-Hinged Frame**

أو **Fixed-Fixed Frame**

و يفضل أخذه **Fixed-Fixed** لزياده ال **moment** عليه

إلا فى حالة التربة الضعيفة يؤخذ **2-Hinged Frame**

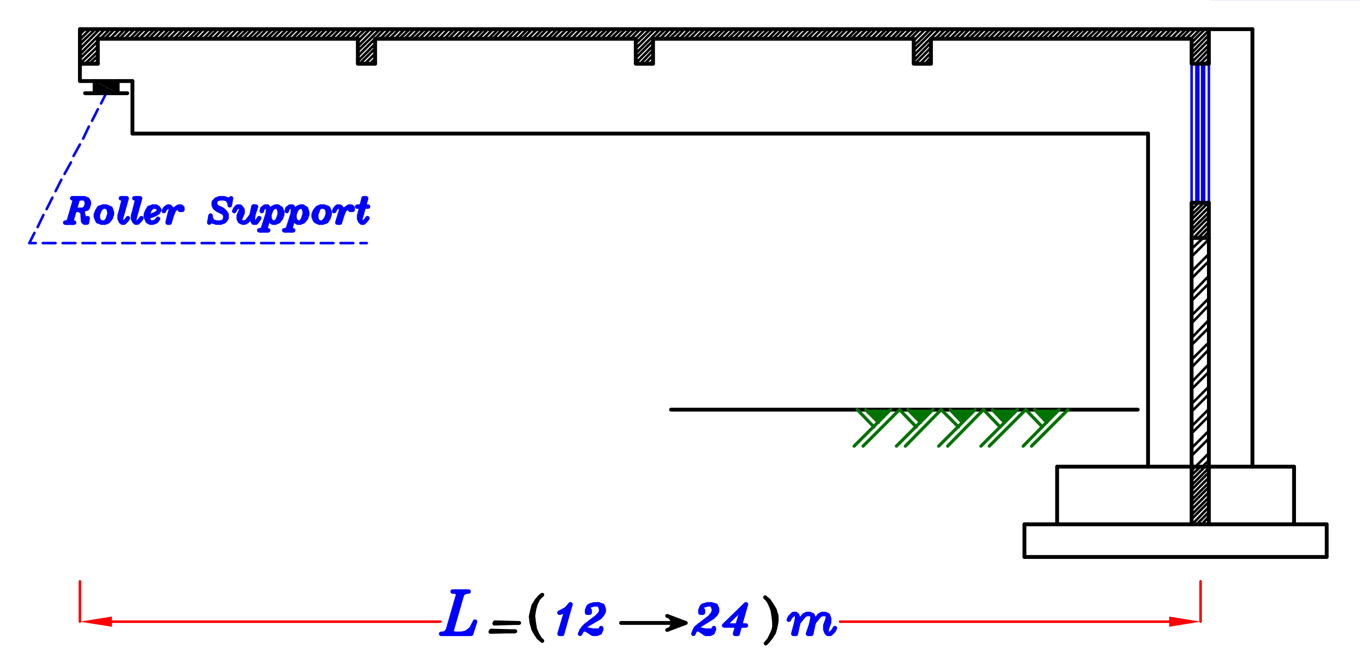
* Span $(L) = (12 \longrightarrow 24\ m)$

* $t \simeq \dfrac{L}{8 \rightarrow 10}$

* $b = (0.50 \longrightarrow 0.80\ m)$

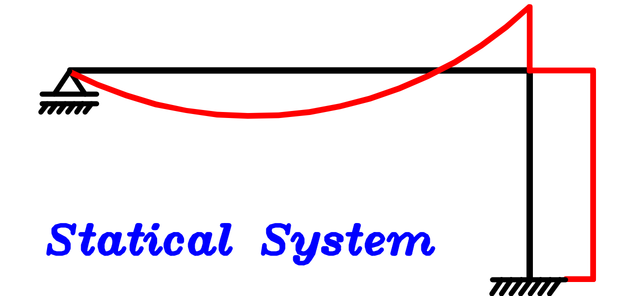
Roller–Fixed Frame.



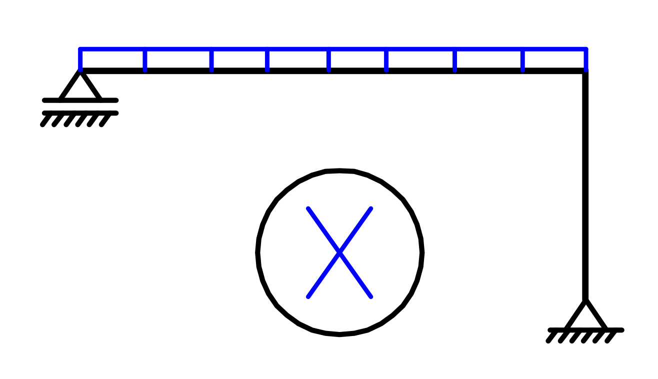


* Span (L) = (12 → 24) m

* $t \simeq \dfrac{L}{10 \rightarrow 12}$



Frame F_1



Hinged–Roller لا يمكن أخذه

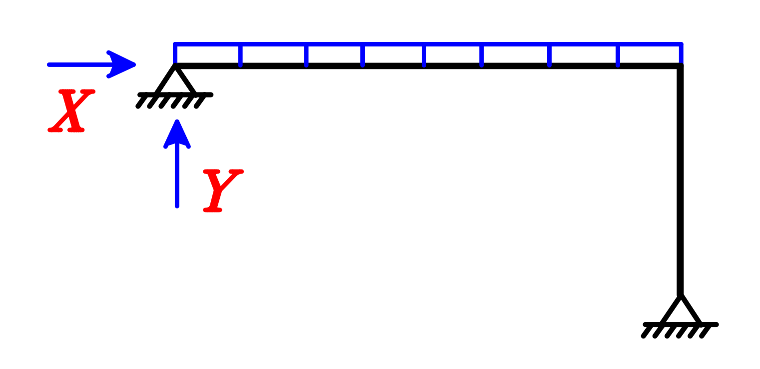
لأنة سيكون **Unstable**

Hinged–Hinged ممكن أخذه

و لكنة حل سيئ لانة سوف

يكون هناك قوه أفقية (X)

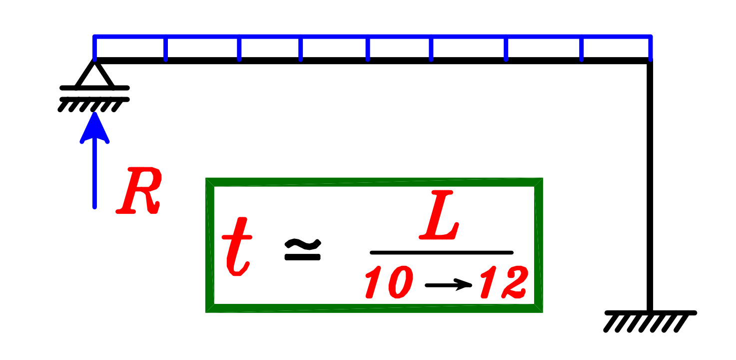
عمودية على ال **Heavy Frame**



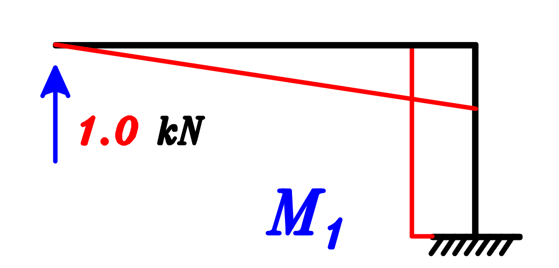
Fixed–Roller أفضل حل أن يؤخذ

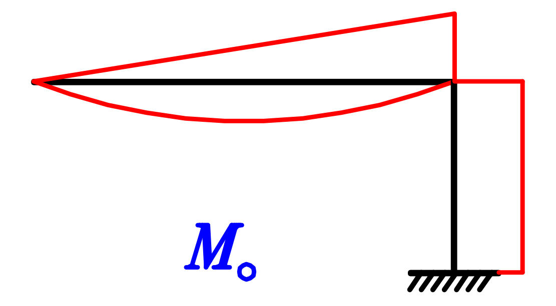
و يُحل بال **Virtual Work Method**

لوجود **Sway** على ال **Frame.**



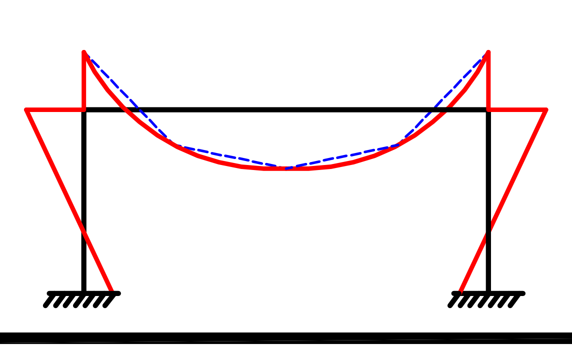
$$t \simeq \frac{L}{10 \rightarrow 12}$$

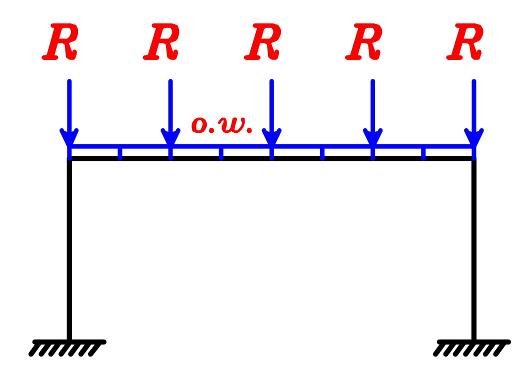




Heavy Frame.

يفضل أخذه **Fixed–Fixed** لزياده ال **moment** عليه

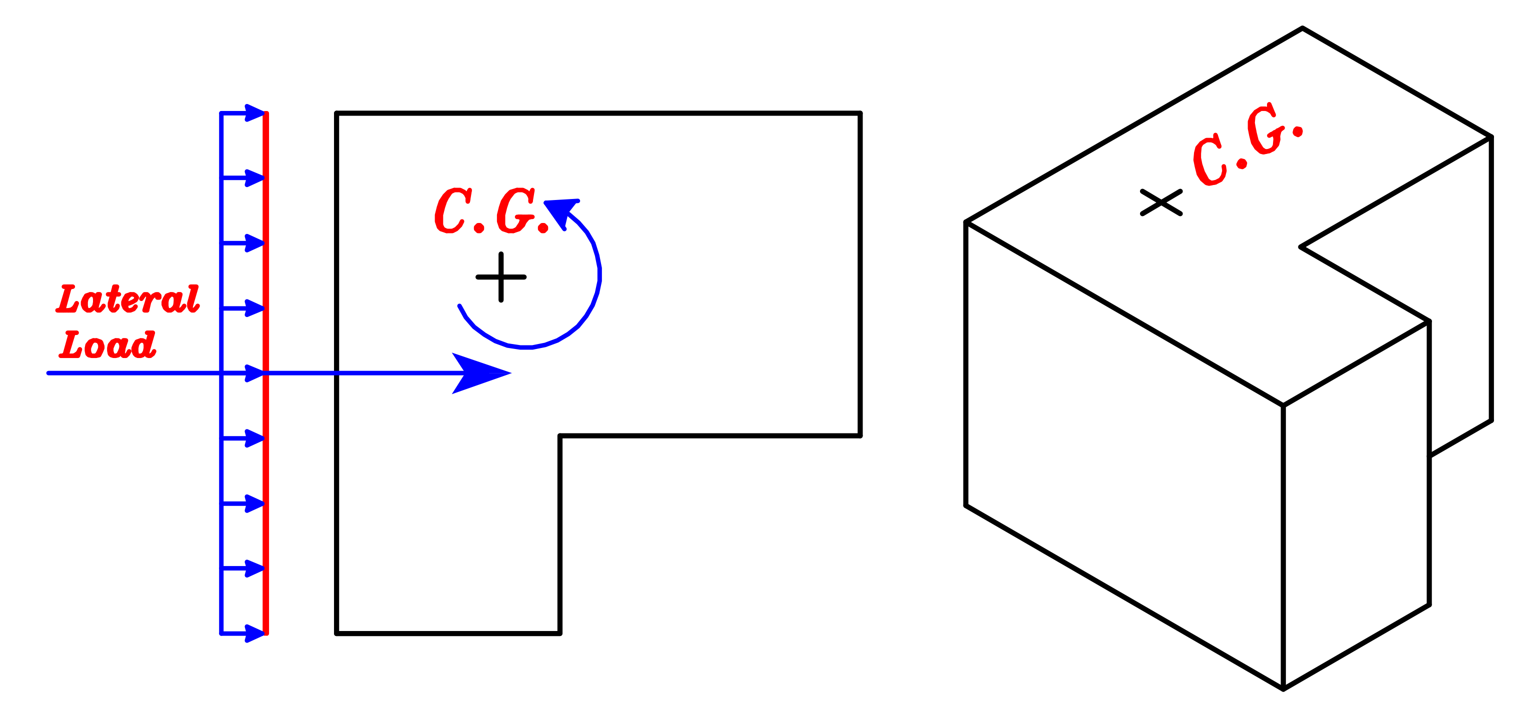




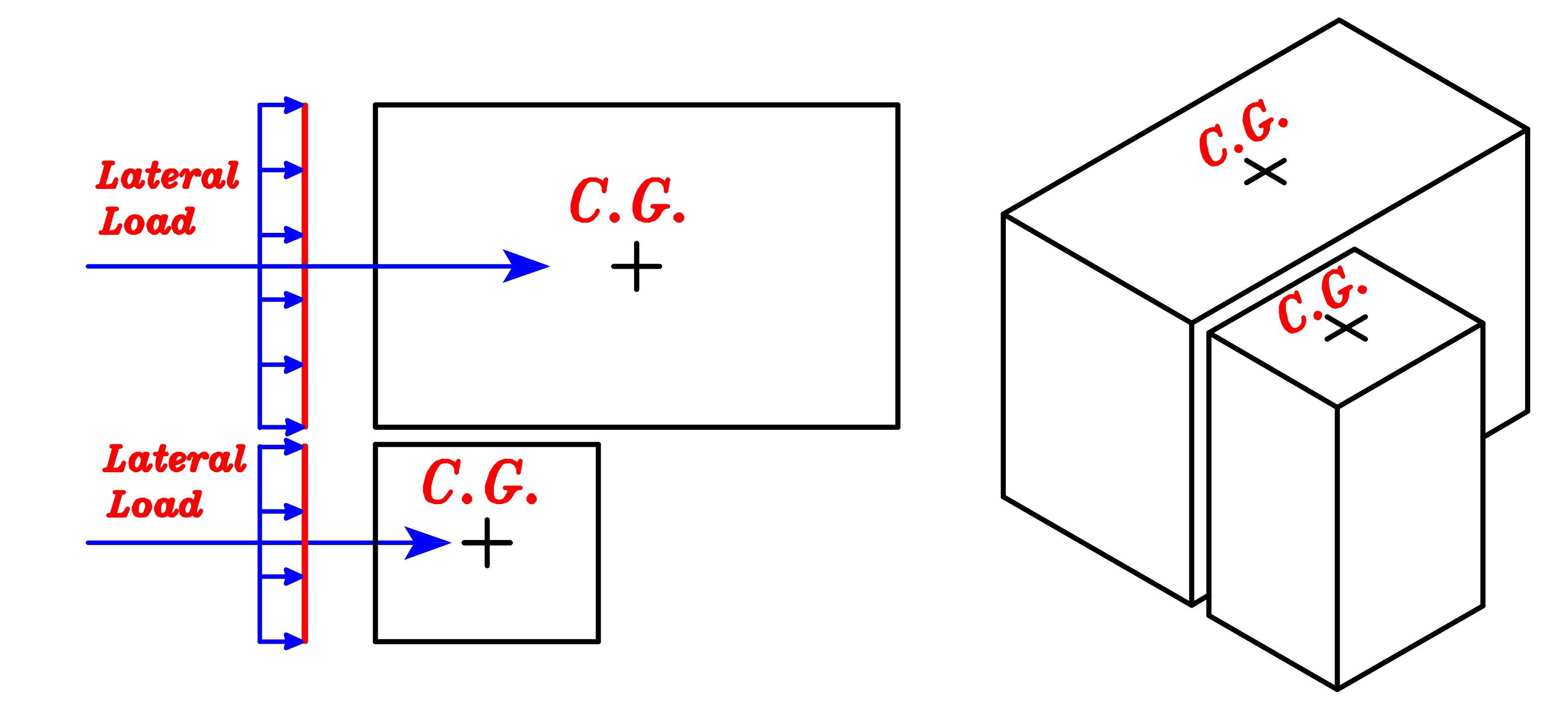
Structural Joint.

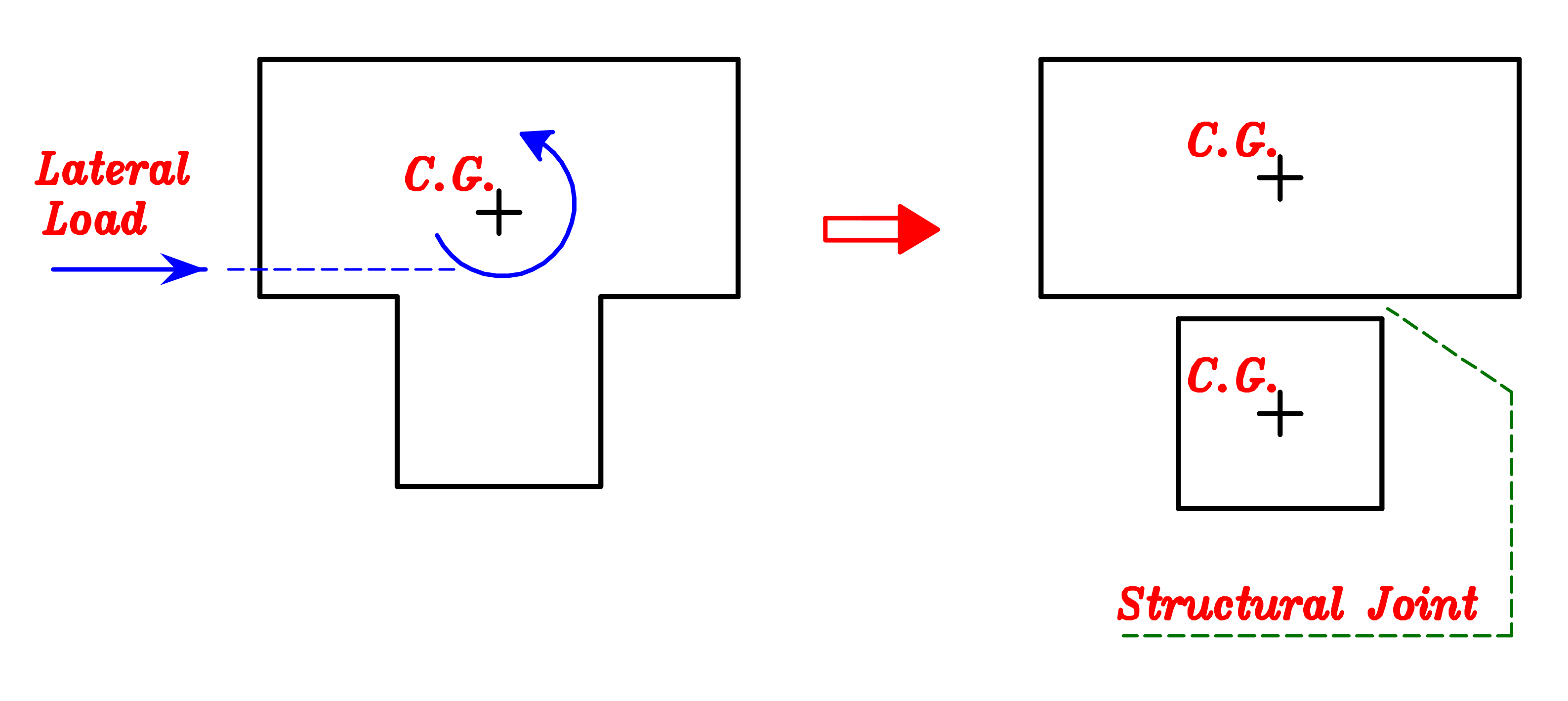
اذا كان شكل المبنى فى ال plan غير منتظم .

مثل المبانى التى يكون شكلها فى ال Plan على شكل L أو T
يكون C.G. للمبنى ليس فى المنتصف و بالتالى عند وجود قوى جانبيه مثل الرياح
أو الزلازل لا تؤثر محصلتها عند ال C.G. و بالتالى تعمل Torsion على المبنى .

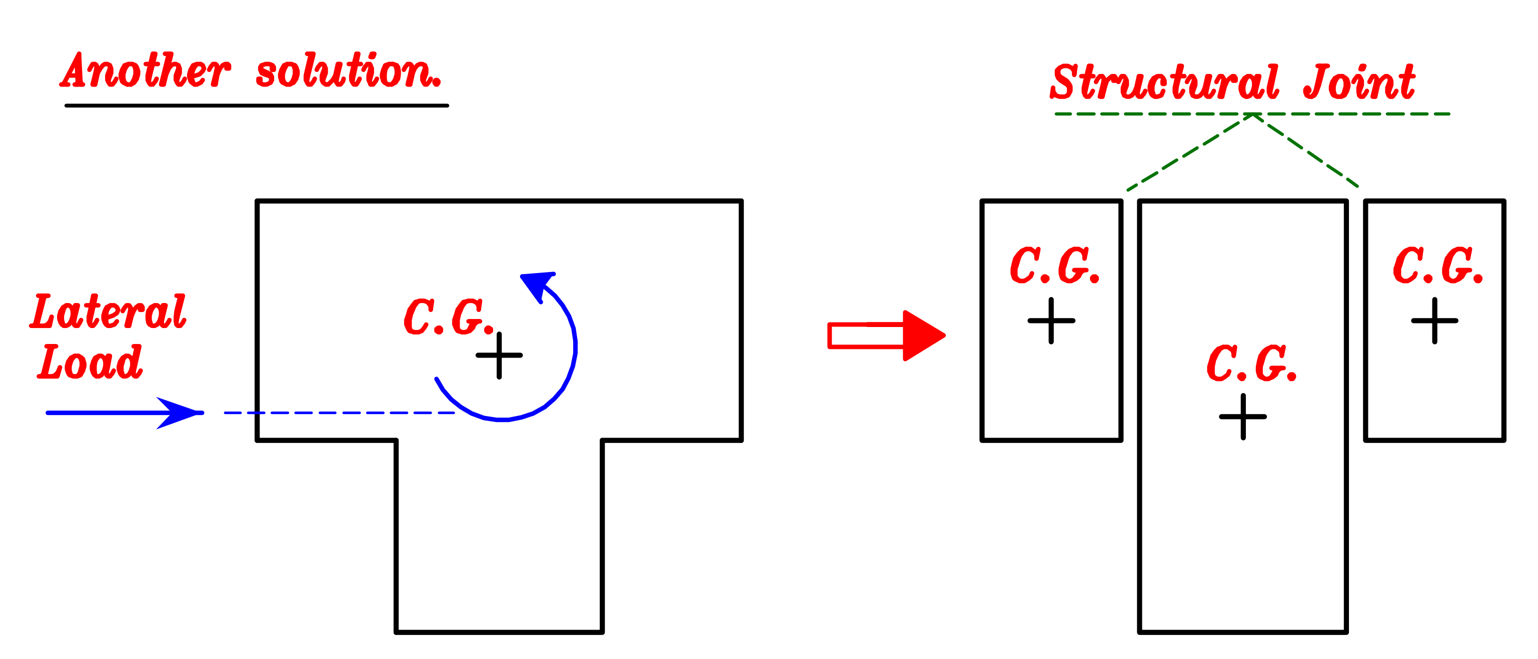


لذا يتم عمل فاصل قدره ٢ سم و ذلك لتحويله الى مبنيان شكل كل واحد منهم
مستطيل فى ال Plan فتؤثر القوى الجانبيه عند ال C.G. لكل منهم على حده .





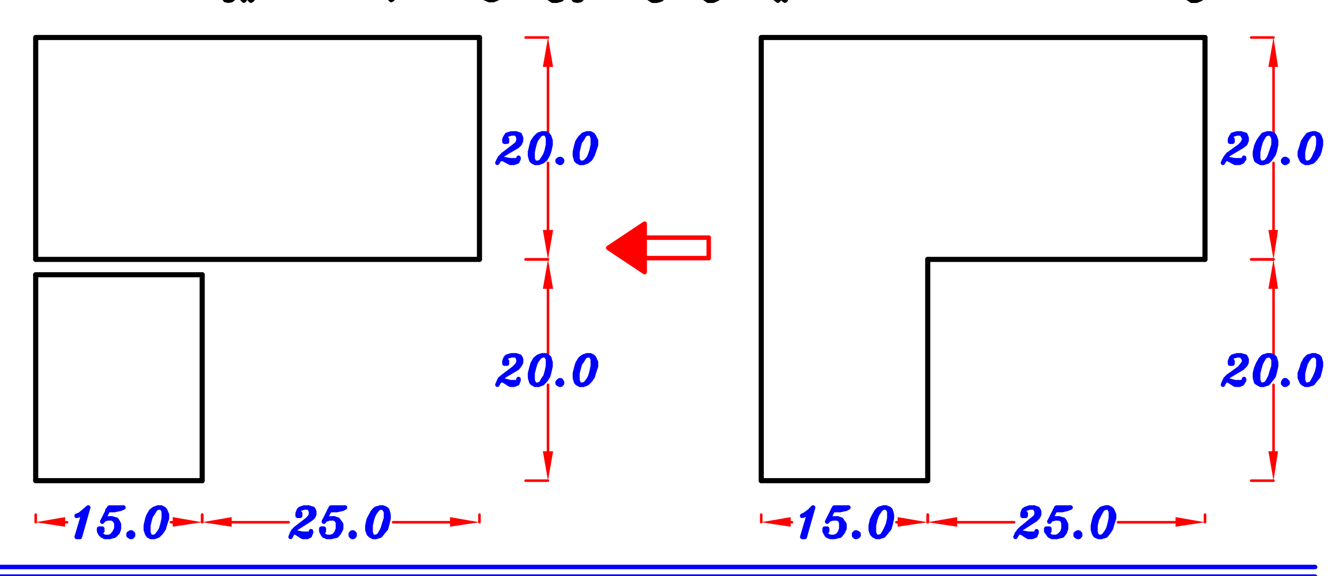
Another solution.



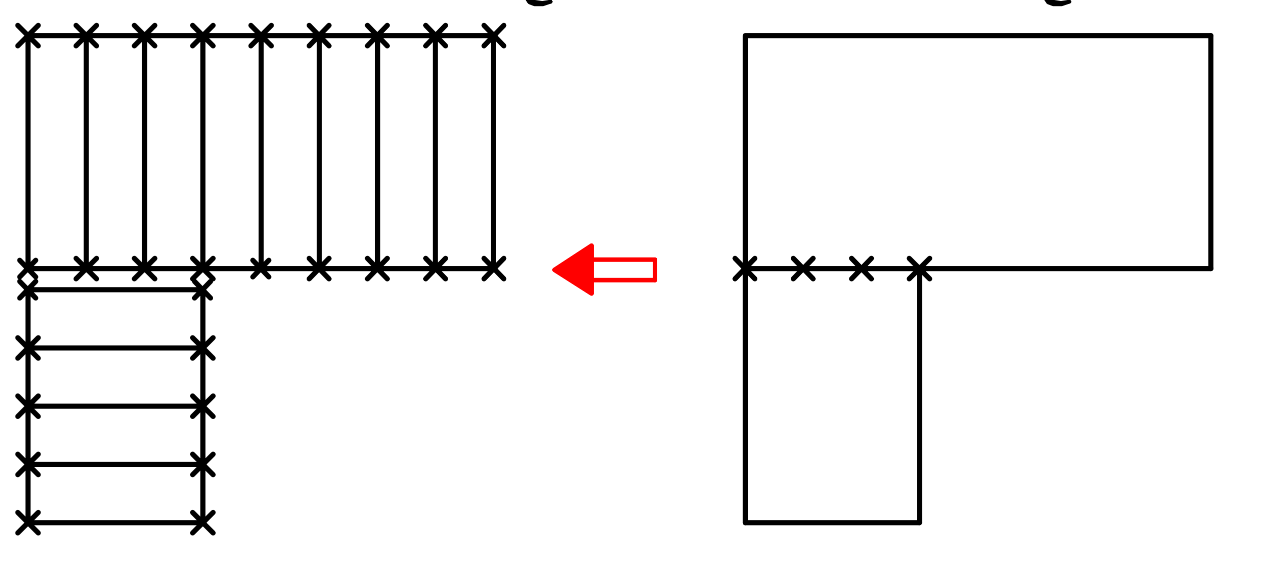
يفضل أن يتم أخذ ال *Structural Joint* فى الاتجاه الاقصر

Note.

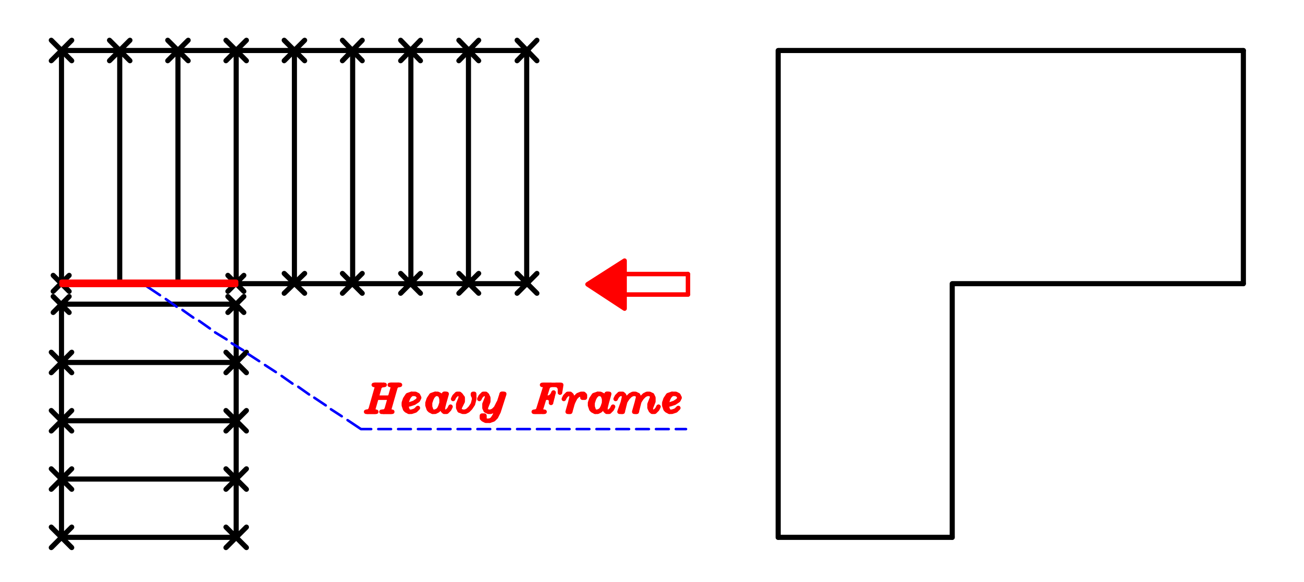
عند عمل **structural Joint** يفضل أن تكون فى الاتجاه القصير



اذا كان مسموح بوجود أعمده داخليه لا نحتاج لـ **Heavy Frame**

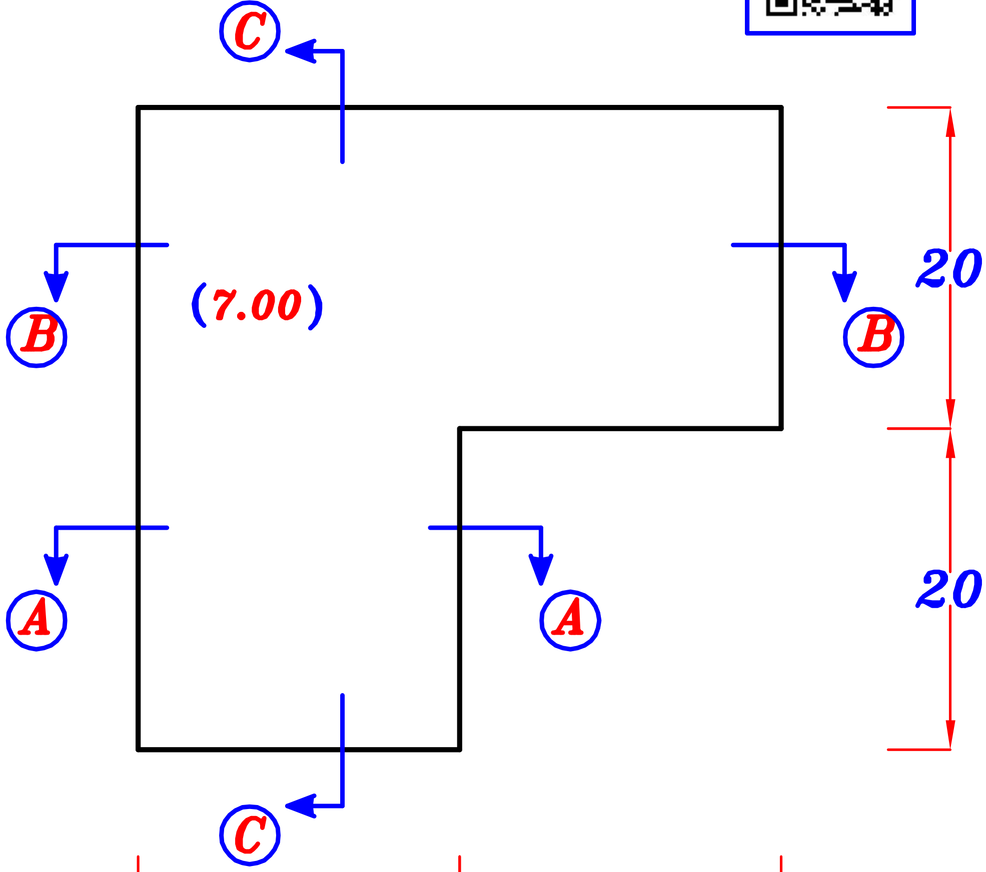


اذا لم يكن مسموح بوجود أعمده داخليه فى المبنى يجب عمل **Heavy Frame**



Example.





F.C. = 1.50 $kN\backslash m^2$

L.L. = 1.0 $kN\backslash m^2$

Roof Level = (+7.00)

Foundation Level = (−2.00)

The columns allowed only at the perimeter of the building.

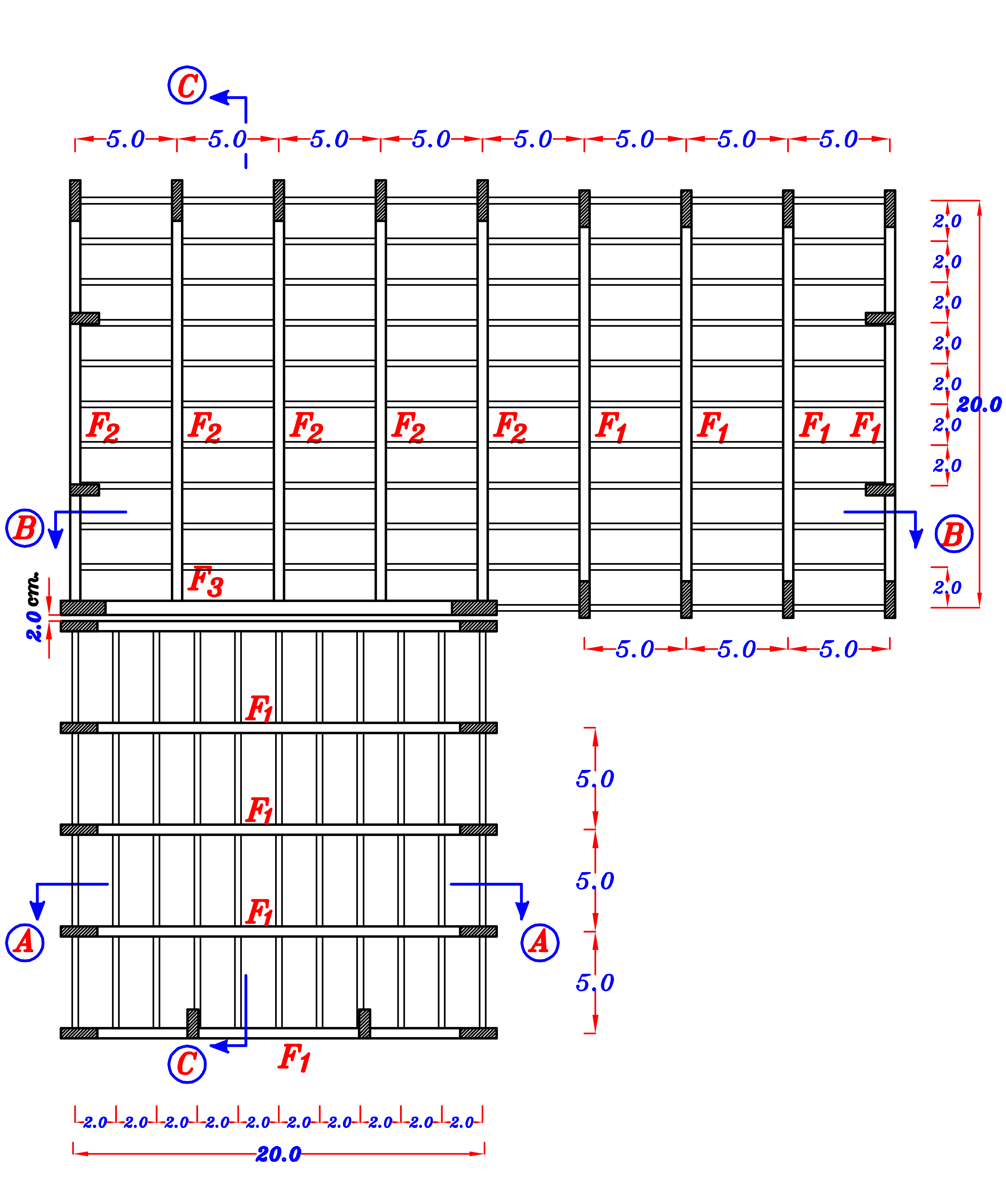
Required.

1- Draw a plan and sections (A, B & C) to scale 1:50

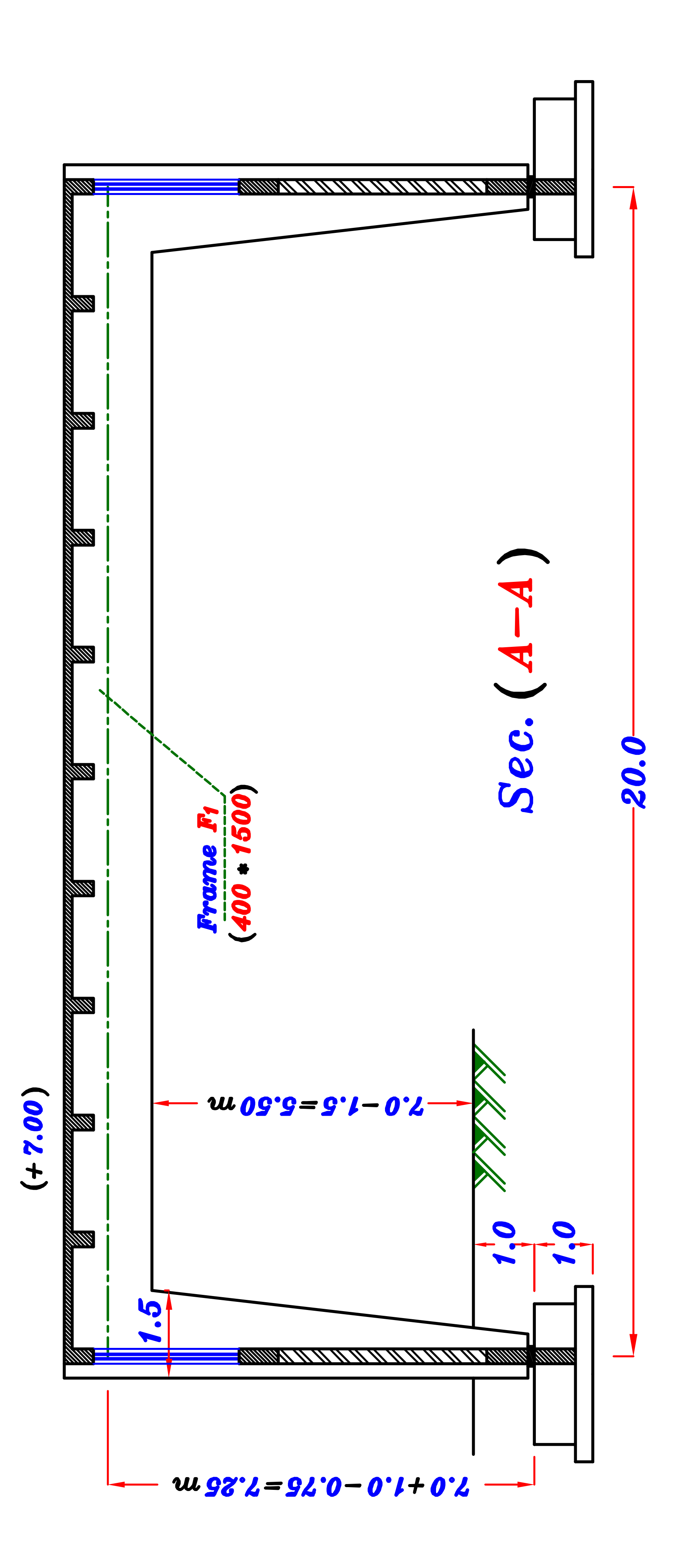
2- Explain the statical system of the main systems.

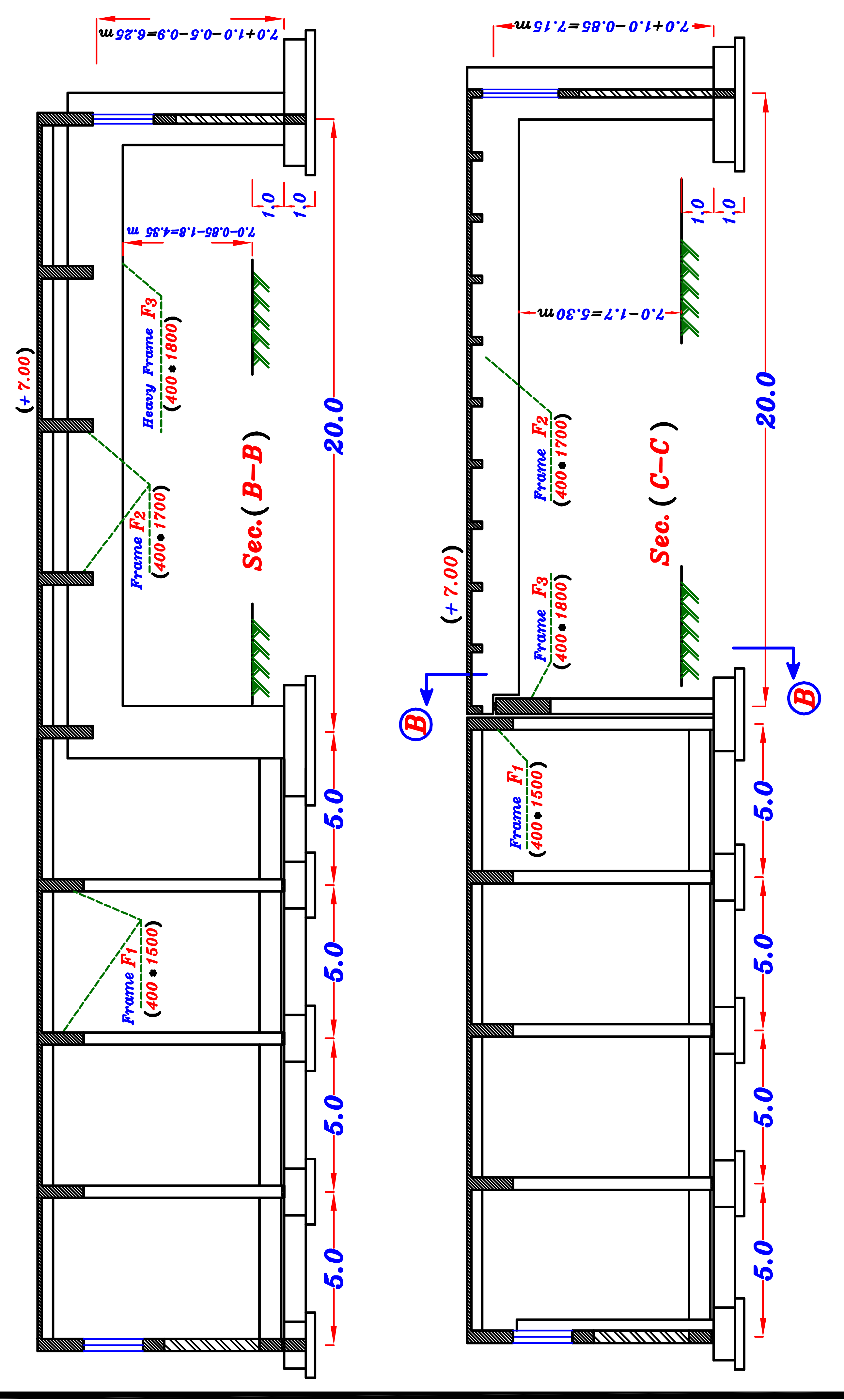
3- Calculate the Loads on the main systems and Draw B.M.D. & N.F.D.

4- Calculate the clear height For all of the main systems.


C
5.0
5.0
5.0
5.0
5.0
5.0
5.0
5.0
2.0
2.0
2.0
2.0
2.0
2.0
2.0
2.0
20.0
F2
F2
F2
F2
F2
F1
F1
F1
F1
B
B
F3
2.0 cm.
5.0
5.0
5.0
F1
F1
F1
5.0
5.0
5.0
A
A
C
F1
2.0
2.0
2.0
2.0
2.0
2.0
2.0
2.0
2.0
2.0
20.0

Plan


Sec. (A-A)
20.0
Frame F1
(400 * 1500)
(+7.00)
7.0-1.5=5.50 m
1.5
1.0
1.0
7.0+1.0-0.75=7.25 m



7.0+1.0−0.5−0.9=6.25 m
7.0−0.85−1.8=4.35 m
1.0
1.0
(+7.00)
Heavy Frame F3
(400*1800)
Frame F2
(400*1700)
Sec.(B–B)
20.0
Frame F1
(400*1500)
5.0
5.0
5.0
5.0
7.0+1.0−0.85=7.15 m
7.0−1.7=5.30 m
Frame F2
(400*1700)
Frame F3
(400*1800)
Sec.(C–C)
Frame F1
(400*1500)
B
B

Load on Slab.

$t_s = \frac{2000}{30} = 66.67\,mm$ Take $t_s = 120\ mm$

$w_s = 1.4\,(0.12 * 25 + 1.50) + 1.6\,(1.0) = 7.90\ kN\backslash m^2$

Load on Beam.

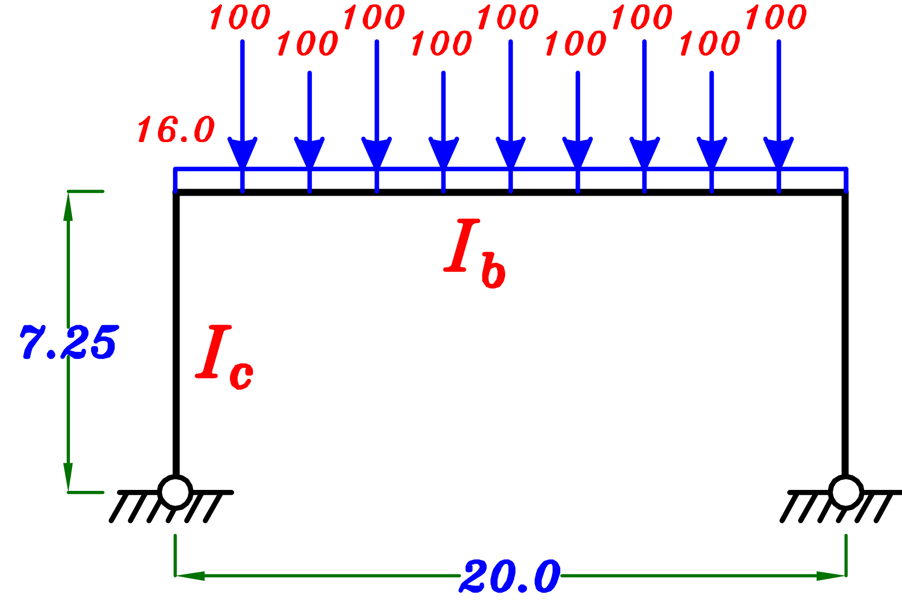
$w_a = o.w. + 2\,w_s\,\frac{L_s}{2} = 4.20 + 2\,(7.90)\,(\frac{2.0}{2}) = 20.0\ kN\backslash m`$

$R = 20.0 * 5.0 = 100\ kN$ $R = 100\ kN$

Frame F_1

Take o.w. of Frame

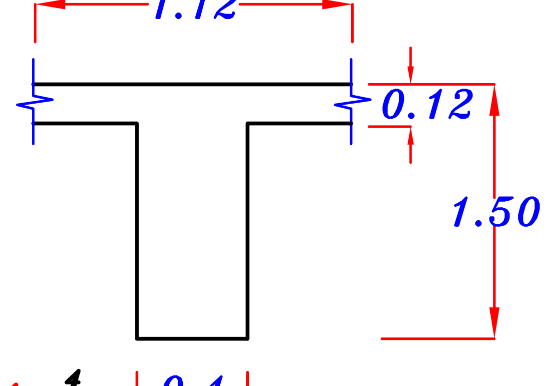
$= 16.0\ kN\backslash m`$ (U.L.)



$I_b = (\mu * 10^{-4})\ B\,t^3$

$b = 0.40\ m\ ,\ t_s = 0.12\ m$

$B = 1.12\ m\ ,\ t = 1.50\ m$



$\frac{t_s}{t} = \frac{0.12}{1.50} = 0.08$

$\frac{b}{B} = \frac{0.40}{1.12} = 0.357$

From Tables page 91 $\mu = 390$



$I_b = (\mu * 10^{-4})\ B\,t^3 = (390 * 10^{-4} * 1.12 * 1.50^3) = 0.1474\ m^4$

$I_c = \frac{b\,(\frac{5}{6}t)^3}{12} = \frac{0.4\,(\frac{5}{6} * 1.50)^3}{12} = 0.065104\ m^4$

$b = 0.4$

$\frac{5}{6}\,t = 1.25$

$\therefore$ $I_b = 2.264\ I_c$

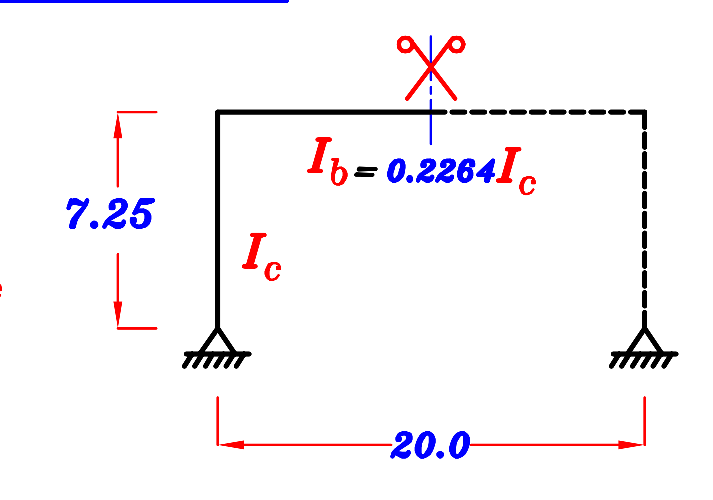
Using Moment Distribution.

D.F.

$$K_c = \frac{3}{4}\frac{I_c}{h} = \frac{3}{4} * \frac{I_c}{7.25} = 0.103\ I_c$$

$$K_b = \frac{1}{2}\frac{I_b}{L} = \frac{1}{2} * \frac{2.264\ I_c}{20} = 0.0566\ I_c$$

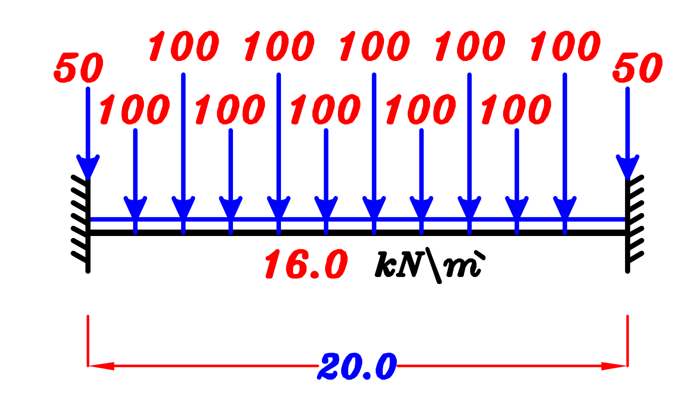
$$D.F._c = \frac{0.103}{0.103 + 0.0566} = 0.645$$



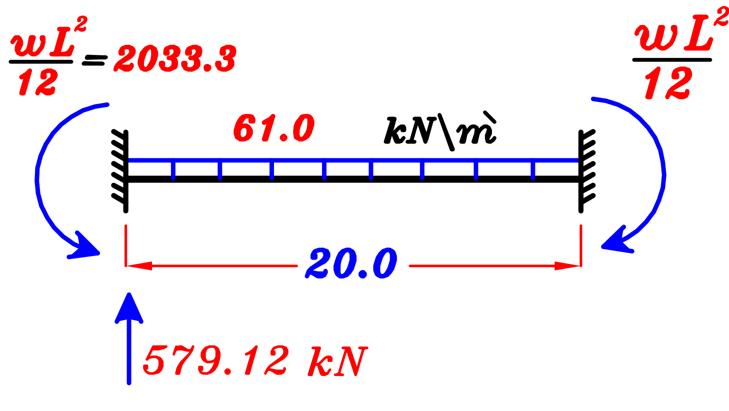
F.E.M.

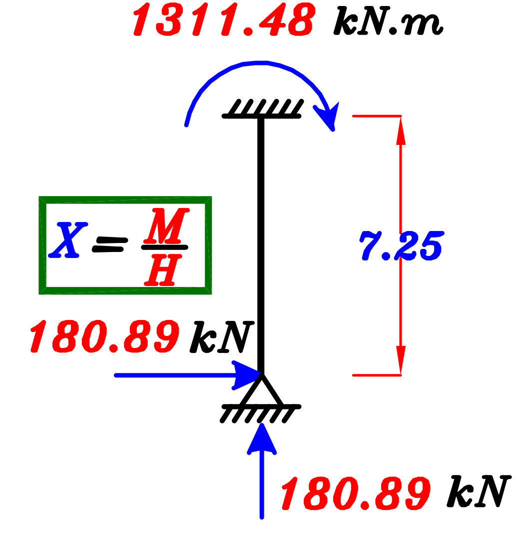
$$w = o.w. + \frac{\sum P}{span}$$

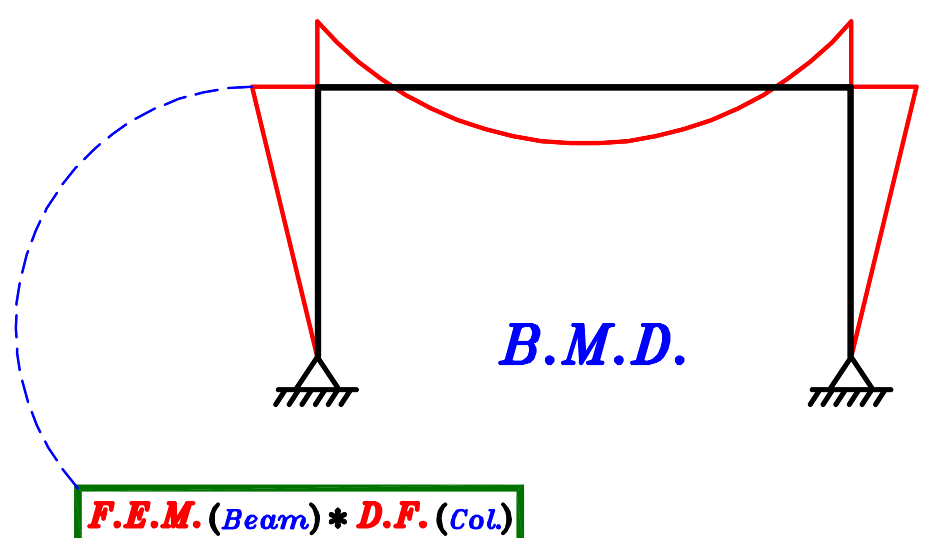
$$= 16.0 + \frac{9\,(100)}{20.0} = 57.912\ kN\backslash m$$



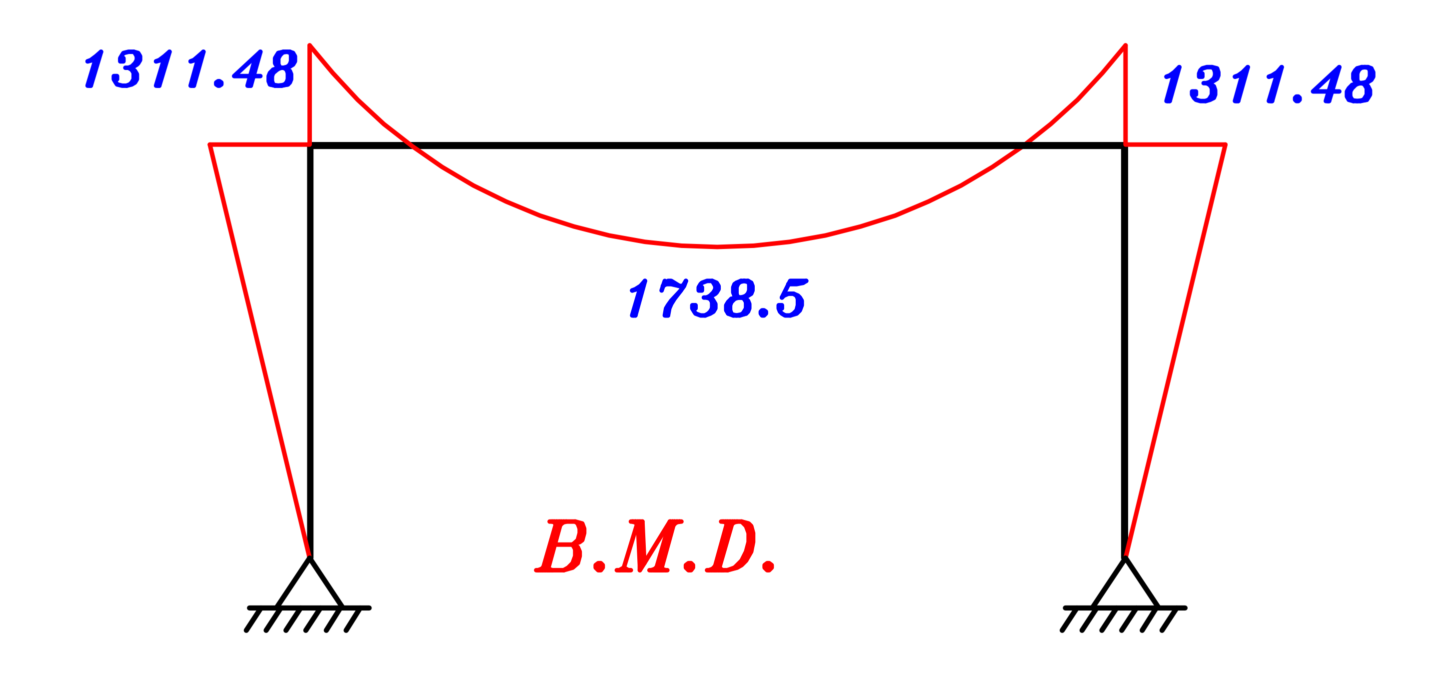
$$\frac{wL^2}{12} = \frac{61.0 * (20.0)^2}{12} = 2033.3\ kN.m$$

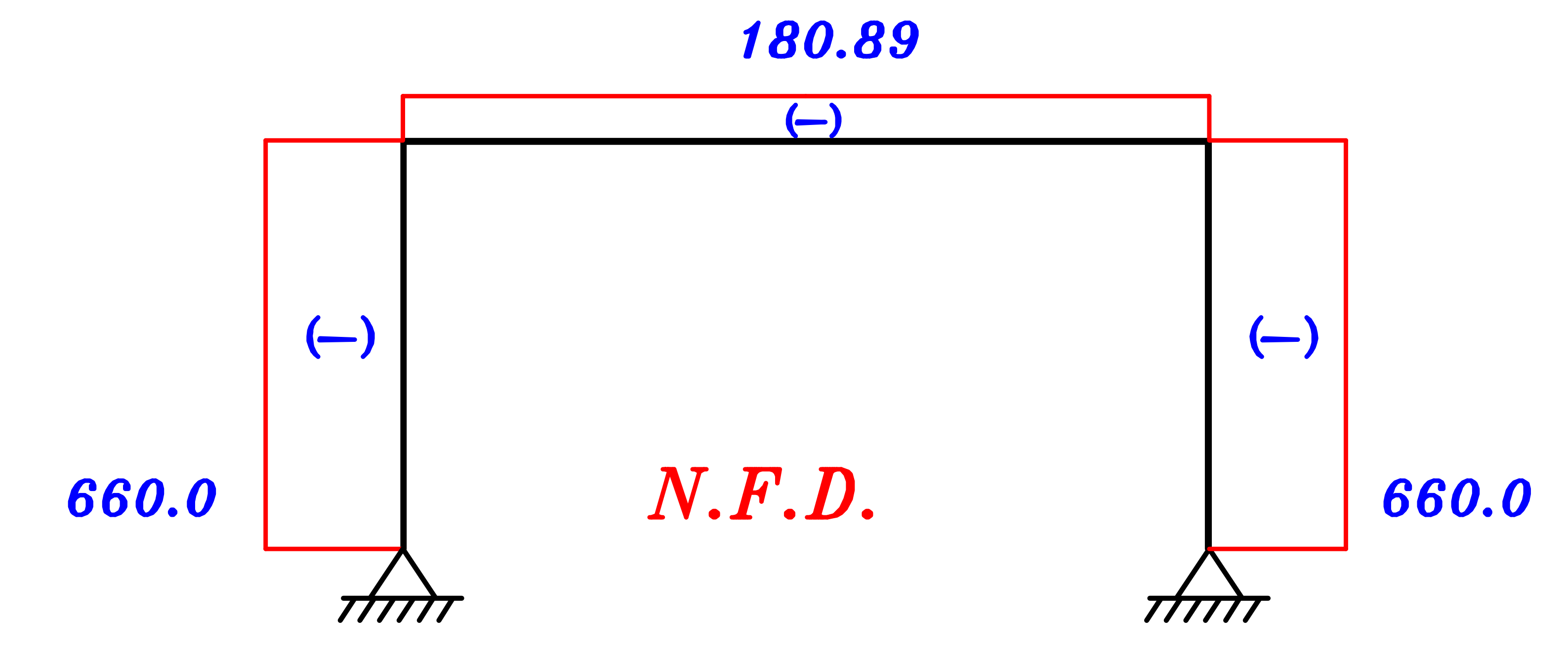






$$2033.3 * 0.645 = 1311.48$$


1311.48
1311.48
1738.5
B.M.D.


180.89
(–)
(–)
(–)
660.0
N.F.D.
660.0

Frame F_2

Fixed–Roller

Take o.w. of Frame

$= 18.0 \ kN\backslash m'$ (U.L.)

100 100 100 100 100 100 100 100 100

18.0

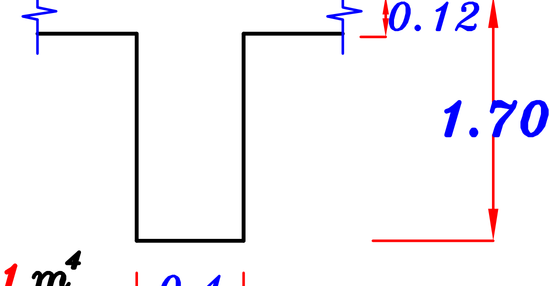
I_b I_c

20.0 7.15

$I_b = (\mu \cdot 10^{-4}) \ B t^3$

$b = 0.40 \ m$, $t_s = 0.12 \ m$

$B = 1.12 \ m$, $t = 1.70 \ m$



$\frac{t_s}{t} = \frac{0.12}{1.70} = 0.0705$

$\frac{b}{B} = \frac{0.40}{1.12} = 0.357$

From Tables page 91

$\mu = 380$

$I_b = (\mu \cdot 10^{-4}) \ B t^3 = (380 \cdot 10^{-4} \cdot 1.12 \cdot 1.70^3) = 0.2091 \ m^4$

$I_c = \frac{b(t)^3}{12} = \frac{0.4(1.70)^3}{12} = 0.1637 \ m^4$

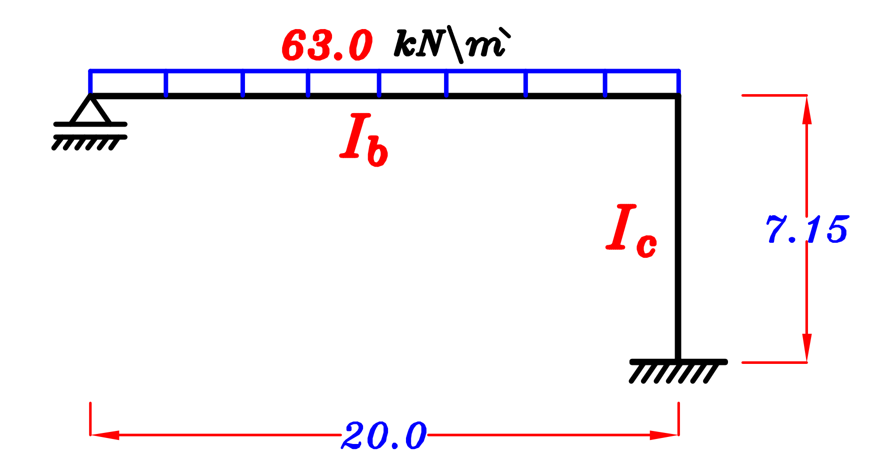
b = 0.4

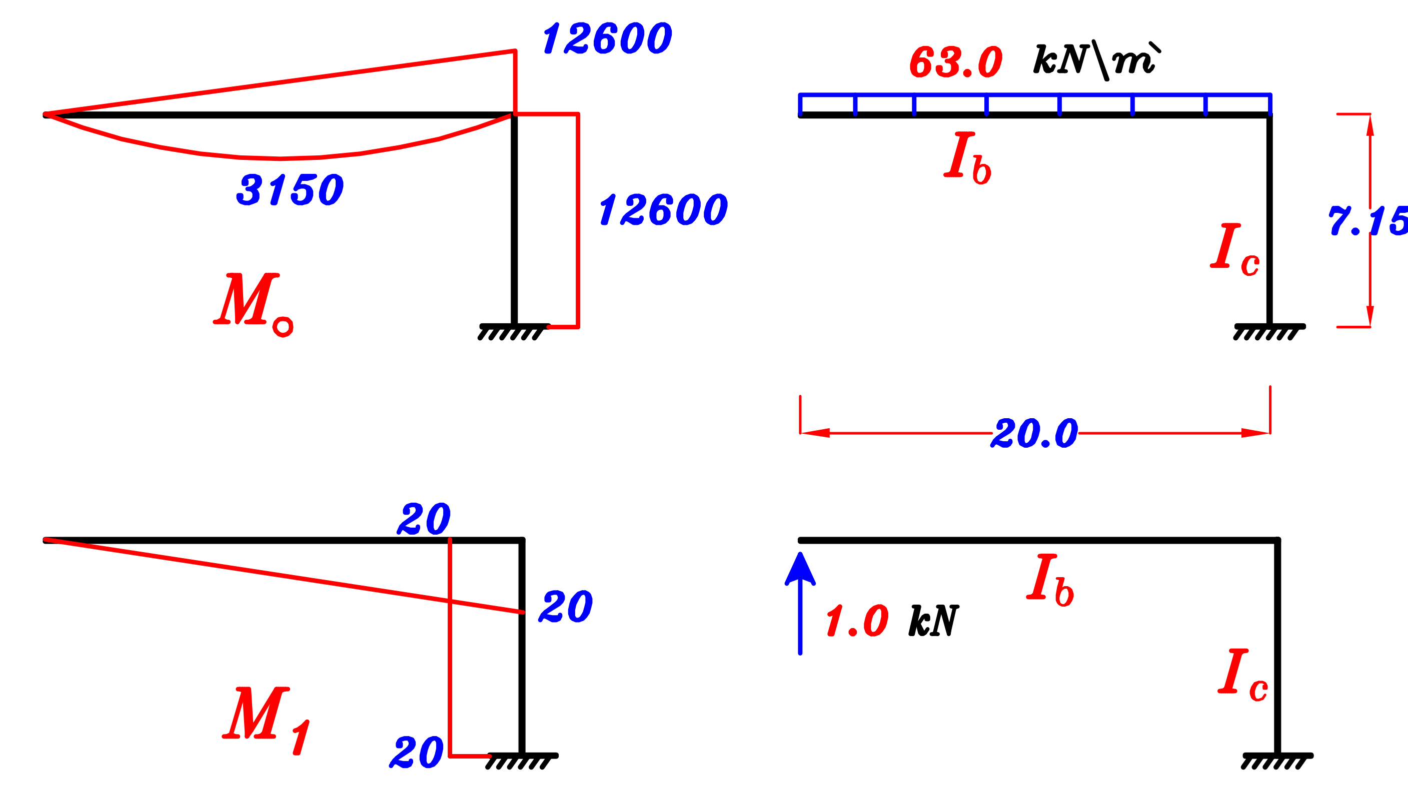
t = 1.70

$\therefore \quad \boxed{I_b = 1.277 \ I_c}$

$w = o.w. + \frac{\sum F}{span} = 18.0 + \frac{9 \ (100.0)}{20} = 63.0 \ kN\backslash m'$

Solve Using Virtual Work Method because there is Sway on the Frame.





$$\delta_{1o} = \frac{1}{E_c I_b} * (M_o * M_1) + \frac{1}{E_c I_c} * (M_o * M_1)$$

$$\delta_{1o} = \frac{1}{E_c (1.277) I_c} \left[-\tfrac{1}{2}(20)(12600)(\tfrac{2}{3} * 20) + \tfrac{2}{3}(3150)(20)(\tfrac{1}{2} * 20) \right]$$

$$+ \frac{1}{E_c\ I_c} \left[-(12600)(7.15)(20) \right] = \frac{-2788487.55}{E_c\ I_c}$$

$$\delta_{11} = \frac{1}{E_c I_b} * (M_1 * M_1) + \frac{1}{E_c I_c} * (M_1 * M_1)$$

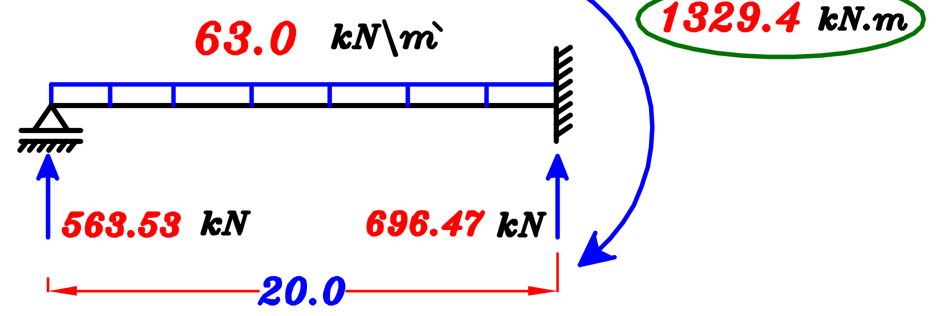
$$\delta_{11} = \frac{1}{E_c (1.277) I_c} \left[\tfrac{1}{2}(20)(20)(\tfrac{2}{3} * 20) \right] + \frac{1}{E_c\ I_c} \left[(20)(7.15)(20) \right]$$

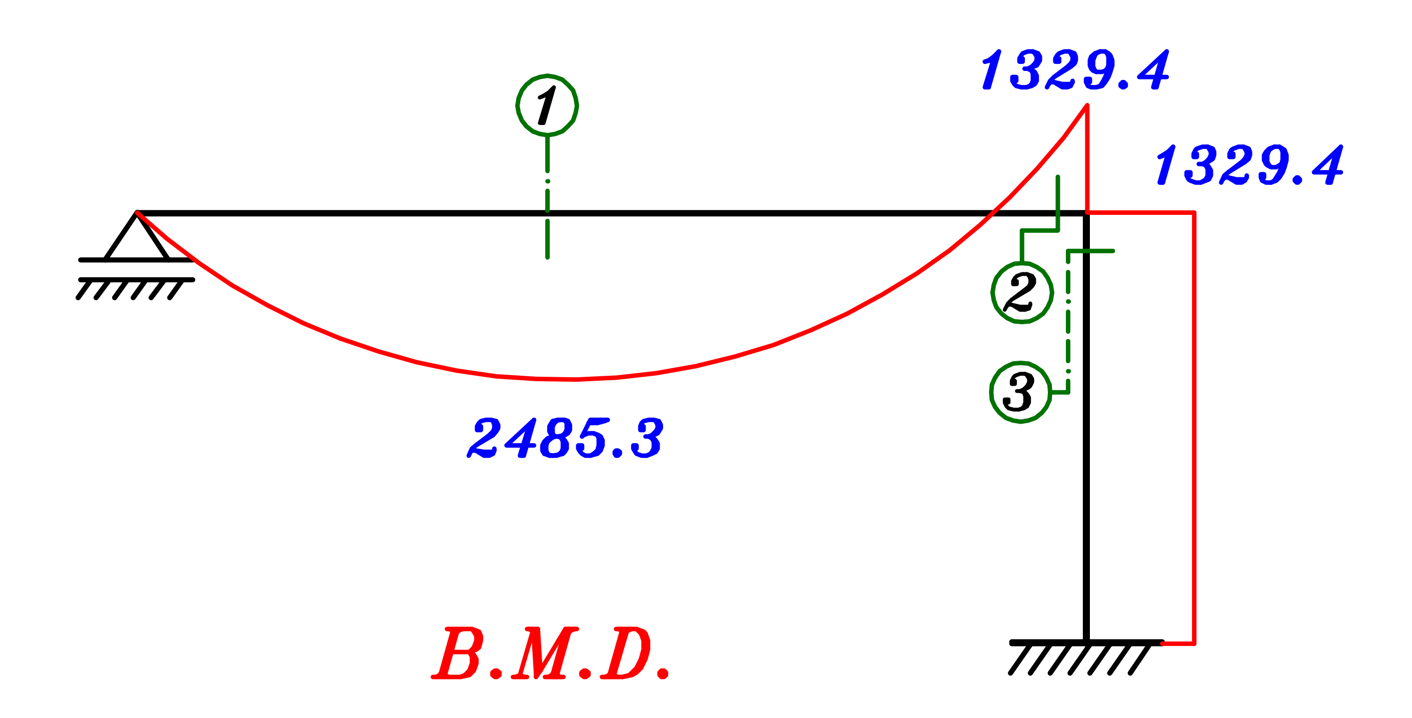
$$= \frac{4948.23}{E_c\ I_c}$$

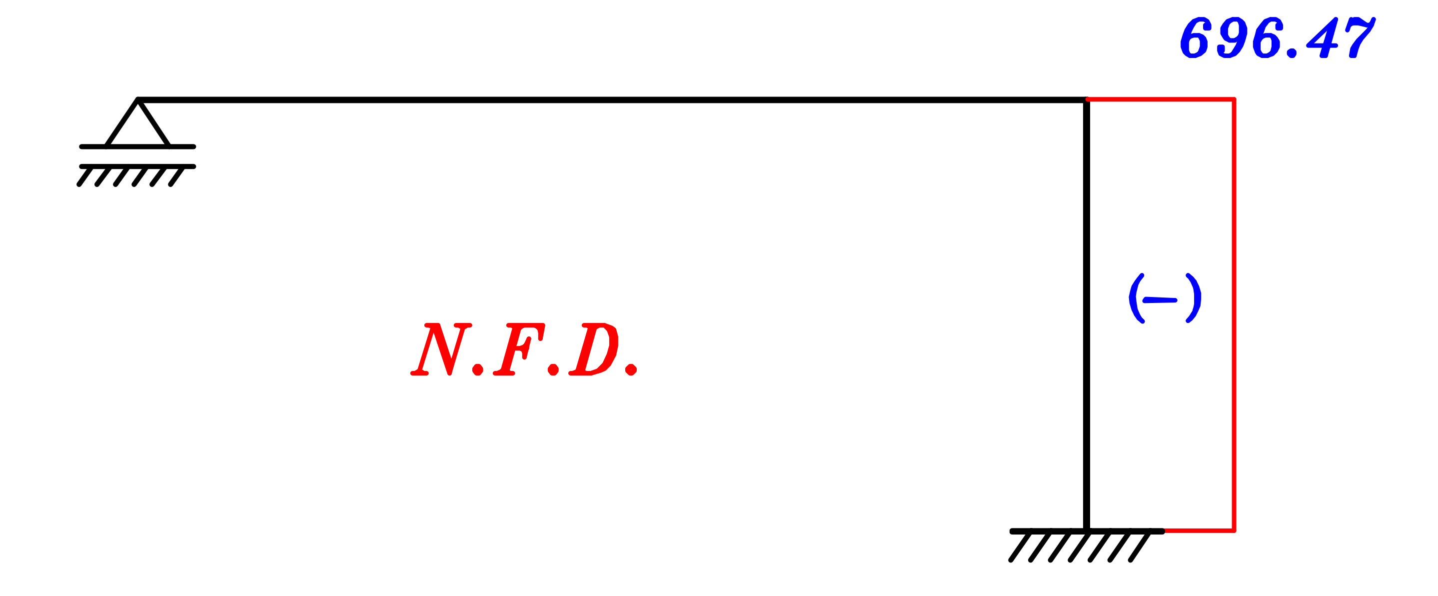
$$\because \quad \delta_{1o} + Y\ \delta_{11} = Zero$$

$$\therefore \quad \frac{-2788487.55}{E_c\ I_c} + Y * \frac{4948.23}{E_c\ I_c} = Zero$$

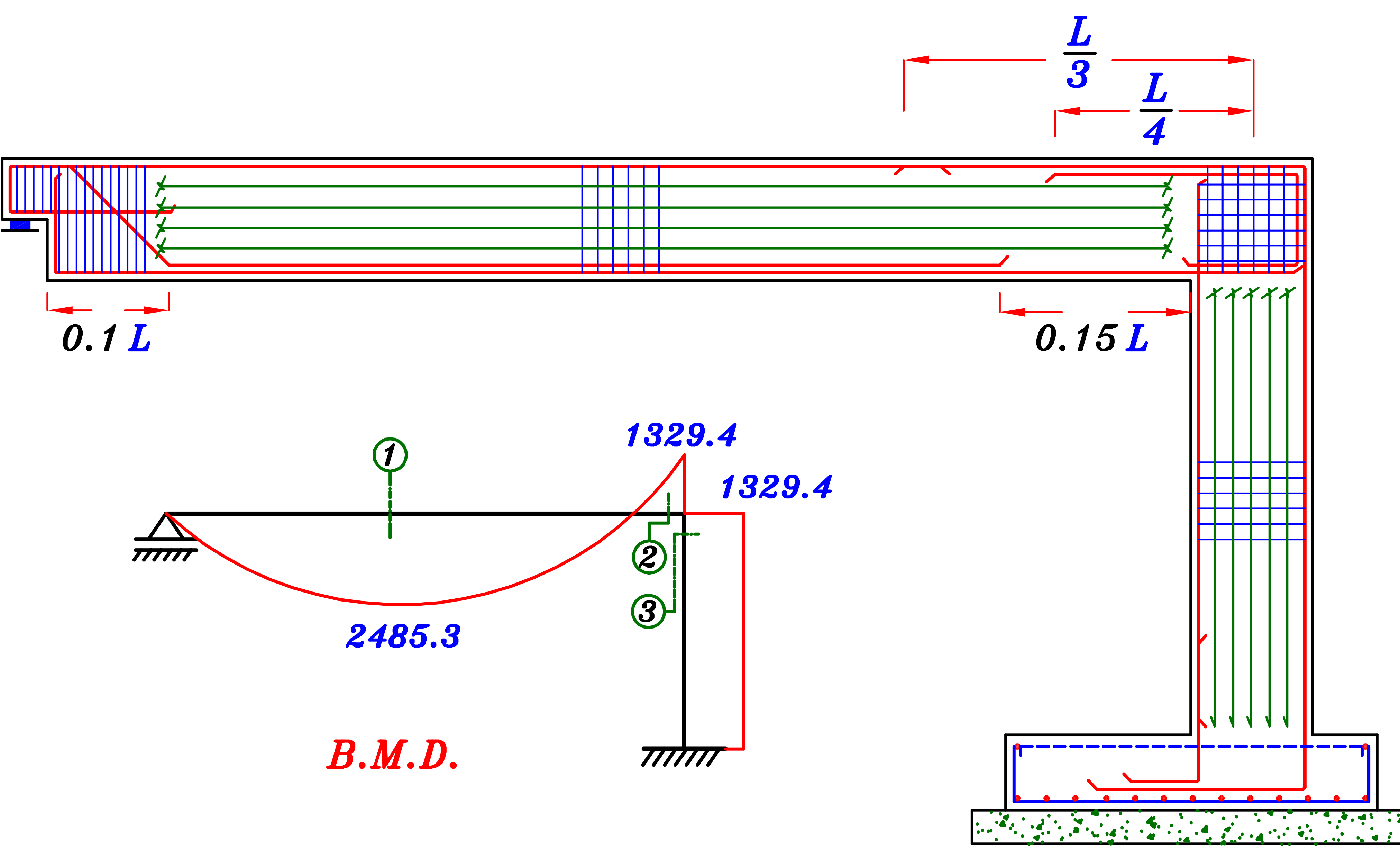
Y = 563.53 kN.m

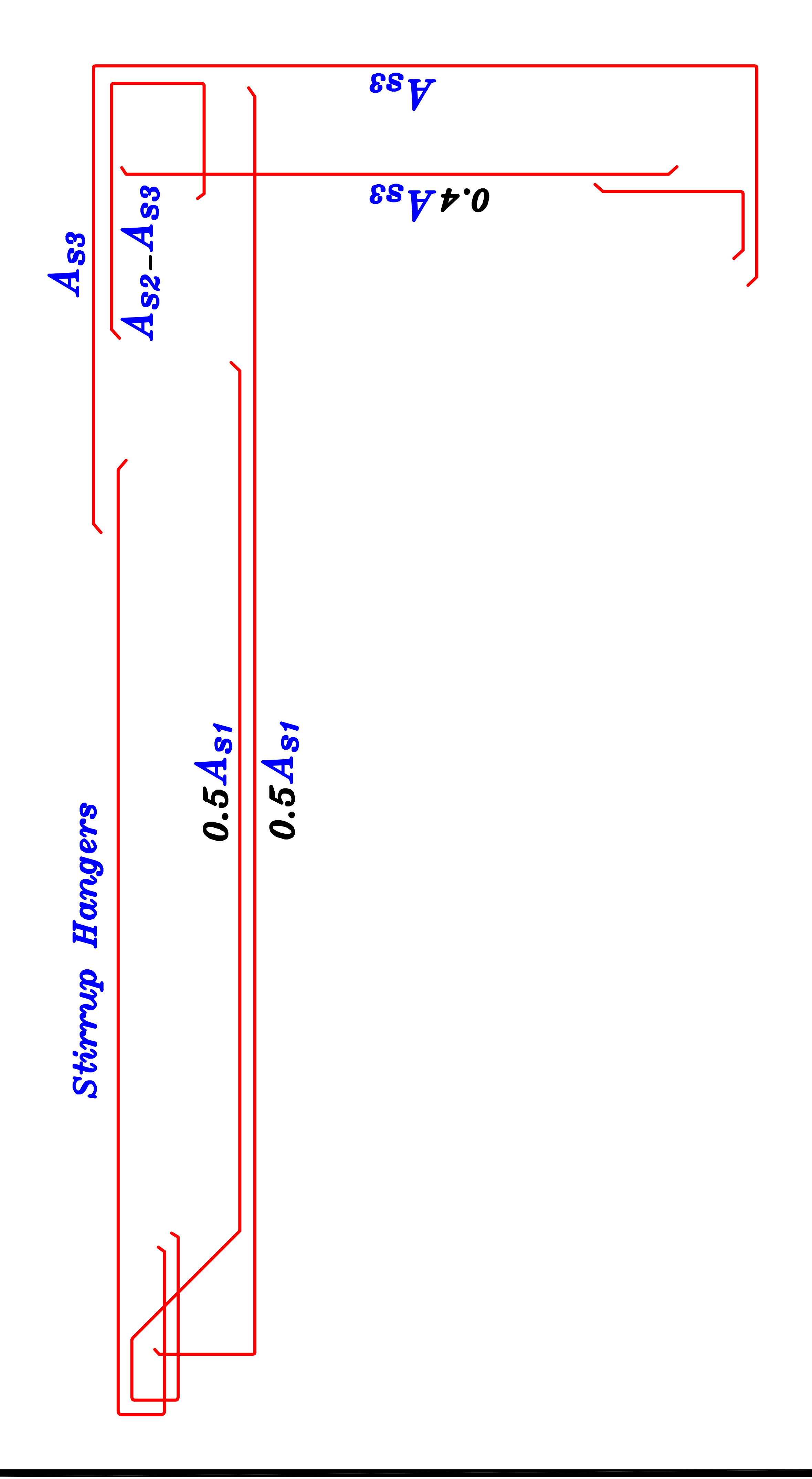



1329.4
1329.4
1
2
3
2485.3
B.M.D.


696.47
(−)
N.F.D.

RFT. of the Frame.



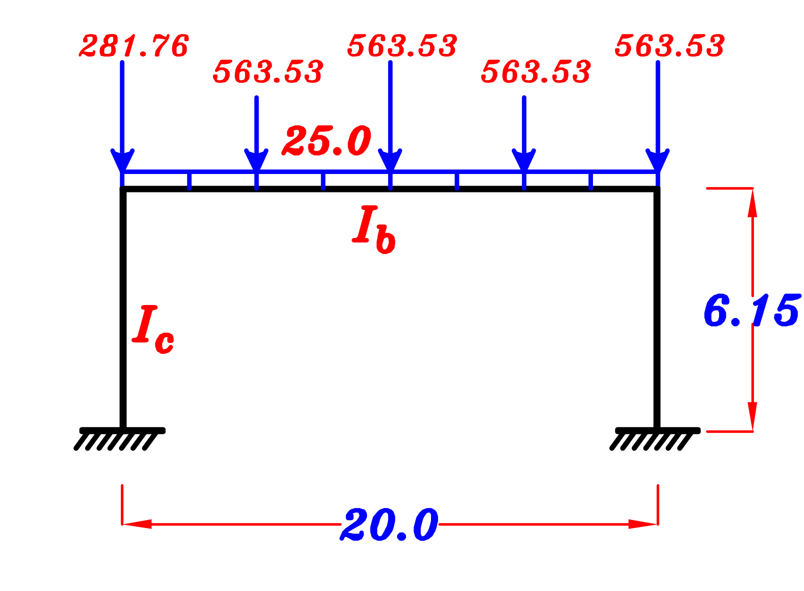

As3
0.4As3
As3
As2–As3
0.5As1
0.5As1
Stirrup Hangers

Frame F_3 (Heavy Frame)

Fixed–Fixed

Take o.w. of Frame

= 25.0 kN\m` (U.L.)



$$I_b = I_c = \frac{b(t)^3}{12} = \frac{0.4\,(1.80)^3}{12}$$

$$= 0.1944 \text{ m}^4$$

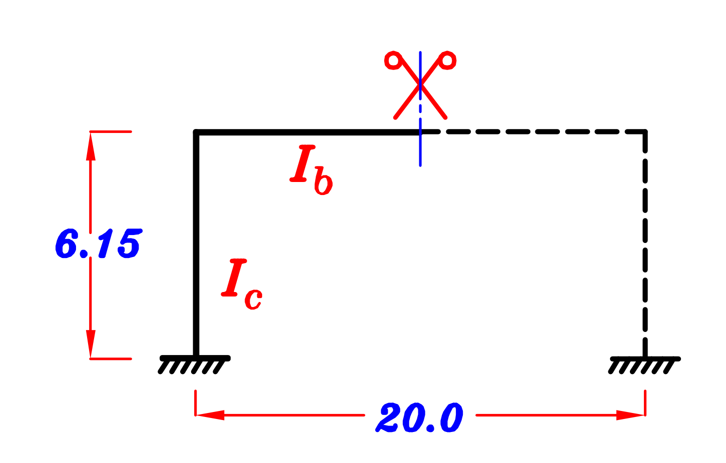
D.F.

For Joint b

$$K_c = \frac{I}{h} = \frac{I}{6.15} = 0.160 \; I$$

$$K_b = \frac{1}{2}\,\frac{I}{L} = \frac{1}{2} * \frac{I}{20} = 0.025 \; I$$

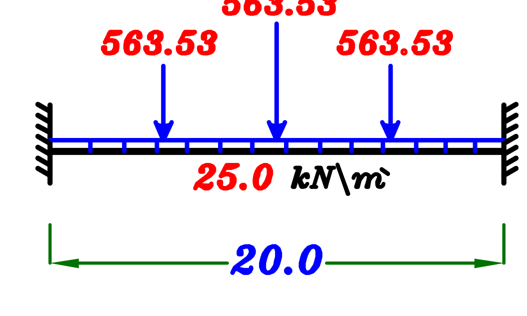
$$D.F._c = \frac{0.160}{0.160 + 0.025} = 0.864$$



F.E.M.

$$M_1 = \frac{F\,a\,b^2}{L^2} = \frac{563.53\,(5)(15)^2}{20^2} = 1584.93 \text{ kN.m}$$

$$M_2 = \frac{F\,L}{8} = \frac{563.53\,(20)}{8} = 1408.825 \text{ kN.m}$$

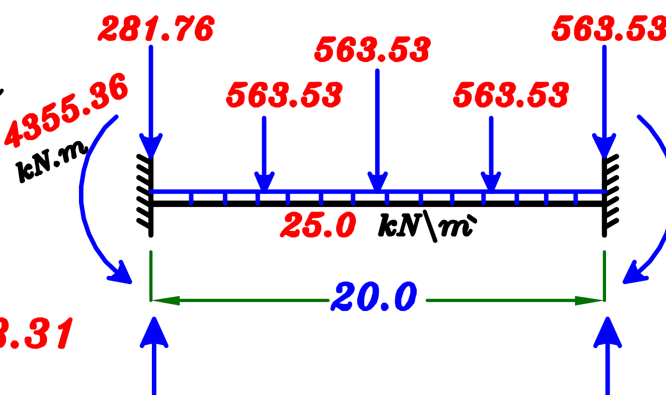


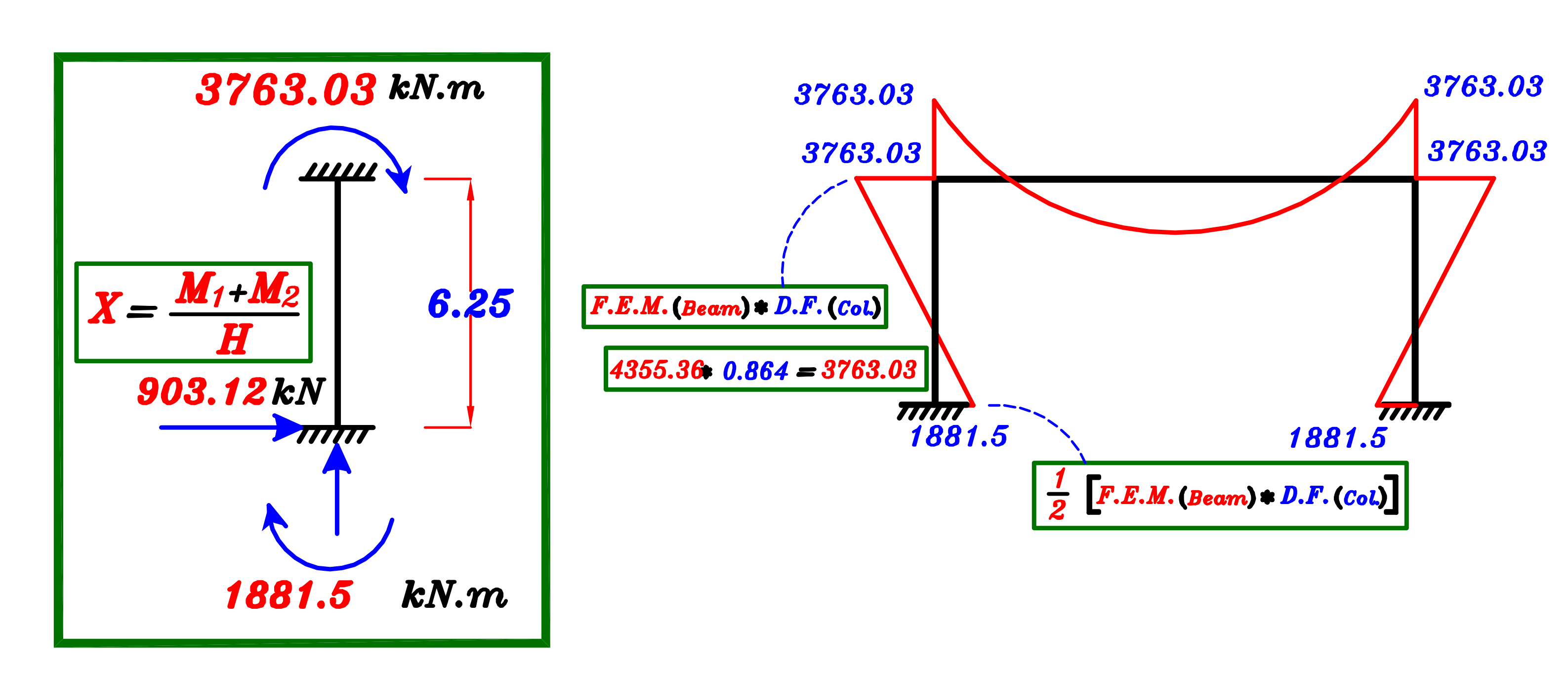
$$M_3 = \frac{F\,a\,b^2}{L^2} = \frac{563.53\,(15)(5)^2}{20^2} = 528.31 \text{ kN.m}$$

$$M_4 = \frac{w\,L^2}{12} = \frac{25.0 * (20)^2}{12} = 833.3 \text{ kN.m}$$

$$\therefore F.E.M. = 1584.93 + 1408.825 + 528.31$$

$$+ 833.3 = 4355.36 \text{ kN.m}$$





3763.03 3763.03

3763.03 3763.03

3122.2

B.M.D.

1881.5 1881.5

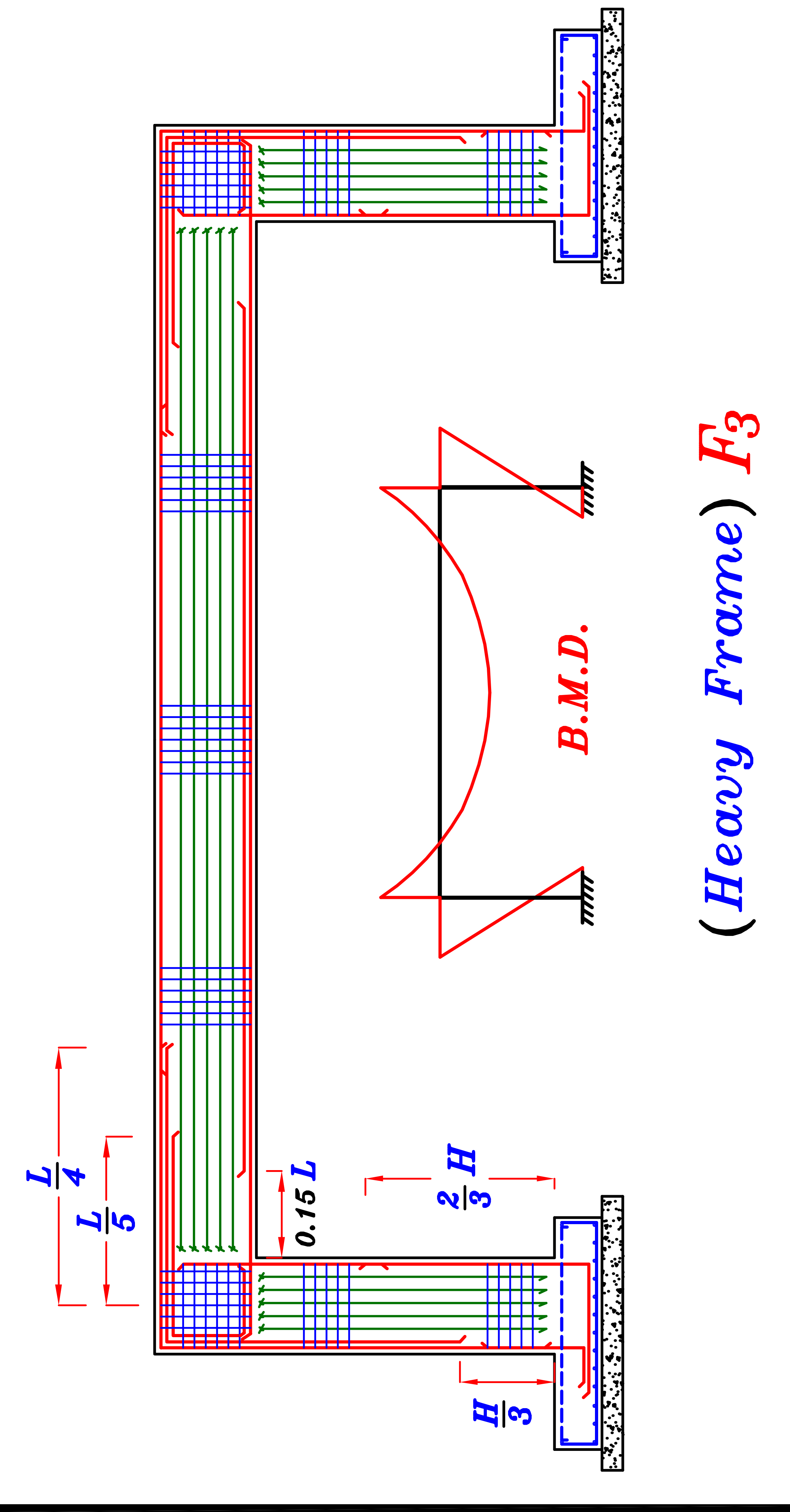
903.12 903.12

1377.05 (–) 1658.82

(–) (–)

N.F.D.

1377.05 1658.82


(Heavy Frame) F_3
B.M.D.
$\frac{L}{4}$
$\frac{L}{5}$
0.15 L
$\frac{2}{3}H$
$\frac{H}{3}$

